

## REMARKS

Claim 14 has been amended. Claims 14-32 remain in the application. Reexamination and reconsideration of the application, as amended, are requested.

Claims 14-32 were rejected under 35 U.S.C. §112, second paragraph, as being indefinite; and further rejected under 35 U.S.C. §103(a) as being unpatentable over JP 6-248491 in view of Free (U.S. Patent No. 5,567,750). Claim 14 has been amended to overcome these rejections. Basis for the amendment is found in the specification at page 12, lines 10-12.

The JP 6-248491 reference teaches a method of producing metallic or metallized complex porous structures comprising the steps of oxidising the materials with a solution of an oxidant, depositing in the gas phase, on the surfaces of the base structure, a monomer and polymerization by oxidation-doping of the monomer into an electroconductive polymer.

The present invention differs from the JP 6-248491 reference:

- by using a solution containing the permanganate/manganate salts and/or cerium IV compounds in the oxidising step,
- by the rinsing step subsequent to the oxidizing step,
- by depositing a monomer which in polimerized form is electrically conductive, in a wet phase,
- draining and drying following the rinsing step subsequent to the oxydizing, draining after water washing step, drying following the rinsing and draining subsequent to the

polymerization by oxidation-doping; and repeating steps (2), (3), and (4) a pre-selected number of times.

According to the present invention, the oxidising pre-treatment, i.e. the first step of the process, is essential and has a double function in producing products according to the invention (page 8, lines 6-11 of the application as filed).

Firstly, it localizes precipitation of the monomer solely on the surface of the fibers or openings within the complex porous structure. Thus, surface priming is carried out by etching the constituent organic material, which produces a surface microporosity leading to the production of an excellent bonding surface for the latter deposit of the monomer.

Secondly, it takes part in polymerizing the monomer from the lower or hidden face. This second function is equally fundamental when one considers that the metallization to be carried out following the premetallization with the conductive polymer must itself be carried out within the complex structure, through its entire thickness. The fineness of the openings, the thinness of the monomer deposit and hence of the polymer, and the limited intrinsic conductivity of the polymer obtained all necessitate a polymerization of the precipitate monomer which is as complete as possible. For this, it is necessary that oxidation of monomer should undergo oxidizing attack which leads to its polymerization not only from its outer surface, but also from its lower hidden face adhering to the bonding surface of the structure's openings of the foam. According to the description, page 9, lines 9-10, it is very important that polymerization of the monomer takes place from both sides.

In order to obtain these two essential functions, the oxidising pretreatment is carried out by using a solution containing permanganate/manganate salts and/or cerium IV compounds, page 8, first paragraph of the description.

The permanganate/manganate salts and/or cerium IV compounds have essential properties that are necessary to obtain the final products of the invention having all the disclosed advantages and features. For this, it is indispensable that deposition of the monomer, before its later conversion in a conductive polymer, must have taken place over the entire surface of the openings, without clogging the surface and internal porosity of the foam (page 7, lines 24-27).

The use of this pre-treatment solution in the specific conditions as disclosed in the example 1, has the advantage of leading to the formation, at the surface of the openings of the foam, of a layer of oxydized products of the oxidizer such as manganese dioxide ( $MnO_2$ ). These oxydized products must be insoluble and must have a sufficient oxidising power to produce the oxidation and therefore, the polymerization of the monomer by its lower face, see example 1, third paragraph. Obviously, these two properties are essential in order to obtain a good deposit of the monomer properly attached on the fibers or openings due to a polymerisation of the monomer in contact with the oxidized products on the surface of the porous structure, i.e. the foam. The layer of insoluble oxidized products only appears when using permanganate/manganate salts and/or cerium IV compound as oxidizer.

According to the examiner, the US patent 5,591,482 effectively teaches the possible use of permanganate salts as an oxidizer, but the process taught is totally different of the one

described in the present application 09/904 375. Any references concerning methods of producing metallic or metallized complex porous structures uses those compounds in examples and all references uses ferric chloride in their best embodiment. He et al. defines ferric chloride as the best compound (column 4, line 28) and, in column 2, lines 18-26 and column 5, lines 54-55, the process includes the step of coating an oxidizer in order to obtain a foam stuck with the oxidizer. None refers to the presence of insoluble oxydized products (manganese dioxide, MnO<sub>2</sub>) of the oxidizer having oxidizing activity on the monomer (see example 1, page 12, lines 11-15). In fact, this reference only disclose the direct use of the oxidizer, and not the remaining insoluble oxidizing products as defined above, coated and stuck on the foam in order to polymerize the monomer on the hidden lower face of the foam.

In He et al., the foam is impregnated with an alcoholic solution of oxidizer (ferric chloride being preferred), then the solvent is removed by vacuum drying (see column 4, lines 53-58) and abstract ("a process of perfectly removing the solvent of the oxidizer solution by vacuum drying").

In fact, only the solvent is removed and of course not the oxidizer, since it has to polymerize the pyrrole when the foam will be placed in the pyrrole gas (column 5, example 1, lines 54-58).

The process here is purely physical, the salt is trapped into the foam after solvent evaporation, and its quantity is high enough to polymerize a rather high quantity of pyrrole (from 9.2 to 39.6% of foam weight, see column 6, example 2, table 2).

On the contrary, the oxidizer used by the applicants oxidizes the base structure and forms a layer of MnO<sub>2</sub>, when potassium permanganate is used (see example 1, page 12, lines 11-15). The potassium permanganate solution is totally removed by water wash, but the MnO<sub>2</sub> stays onto the foam, since it is insoluble in water and bonded to the polyurethane, as explained before. Nevertheless, the quantity of MnO<sub>2</sub> which stays onto the foam cannot polymerize the pyrrole which is trapped by the foam (see example 1, 5g of pyrrole per sqm of foam which density is 50g/m<sup>2</sup> ≡ 10% of pyrrole per weight).

Pyrrole is fully oxidized and polymerized during step 5, when foam impregnated with pyrrole is immersed in a solution containing ferric chloride.

Bearing in mind all the sub-mentioned differences between the invention and the references cited by the Examiner, it is clear that the oxidizing property of permanganate/manganate salts and/or cerium IV compounds is used in order to coat the surface of the openings of the foam, of a layer of insoluble oxydized products such as manganese dioxide and not as a direct oxidizer of the monomer. Any document neither discloses nor suggests this essential feature. Advantageously, the presence of these oxydized products allows to easily and immediately rinse the structure after the oxidizing pre-treatment in order to avoid undesirable thinning of the structure and/or rupture of the openings of the foam (page 9, lines 25-34 of the description).

- Foam porosity

US patent 5,567,740 teaches the manufacture of a high porosity polyurethane foam which is rendered conductive by mixing an antistatic agent to the reactants which are necessary for manufacturing polyester foam (isocyanate and polyol).

The foam has very low conductivities ( $1.5 \cdot 10^{11}$  to  $1.19 \cdot 10^{14}$  ohms.cm at room temperature, see column 9, table 1) and is used to eliminate static charges. The patent does not describe the electroplating of metals onto this foam.

There is no teaching in the US patent 5,567,740 on how to use high porosity foam to make it conductive in combination with the Japanese patent 06248491.

- Use of acetonitrile

The conductive foam described by the applicant is rendered conductive by chemical means and not as it is taught by Japanese patent 06248491, by mixing chemical and electrochemical means.

The Japanese patent 06248491 describes a process where an additional layer of polypyrrole is deposited onto the foam by electrolytic polymerization, pyrrole being dissolved in acetonitrile. Acetonitrile is used as solvent and not as polymerizing agent.

Men of the art can understand that the conductivity of the foam after the first step, i.e. after formation of polypyrrole by chemically oxidative polymerization of pyrrole, is not sufficiently high to make possible an electroplating of the foam with nickel.

One can understand that the penetration of pyrrole vapor is difficult because of the very low pores size of the foam which is used as substrate (100 microns as mentioned in the abstract), and that an additional step of electropolymerization is necessary to increase foam conductivity and polypyrrole distribution into the foam.

Moreover, Japanese patent JP 06248491 describes foam which is rendered conductive by a first impregnation with ferric chloride followed by immersion in pyrrole vapor.

An additional layer of polypyrrole is formed by electropolymerization, the foam pre-coated with polypyrrole being dipped into a bath with acetonitrile as solvent, in which is dissolved pyrrole. The foam is used as an anode.

The use of permanganate instead of ferric chloride would not change the fact that the foam after immersion in pyrrole vapor is not conductive enough.

An additional layer of polypyrrole has to be deposited onto the foam by electrochemical oxidation for a further electroplating of nickel.

The inventors claimed the use of an ester urethane foam with cells size of approximately 100 microns. The applicants describe foam to be metallized as polyurethane foam of 100 PPI grade (see example 1). Referring to a commercial data sheet from FOAMEX, a US foam manufacturer, 100 PPI foam has an average cell diameter of 150 microns. The applicants describe a conductive foam which does not require the deposition of polypyrrole by electropolymerization, even when the foam used has small pores (i.e. about 150 microns), and which can be further electroplated after chemical polymerization of pyrrole.

In conclusion, even if, according to the Examiner, the products seem to be identical because they comprise structural similarities, the microphysical and physical features of the metallized products are very different. Combination of all steps of the process allows to have a new product with a rapid and uniform deposit of polymer over a layer of insoluble oxydized products such as manganese dioxide and, thus, of metal over the entire surface of each opening of the foams. The

use of the new process according to the invention leads to obtain new products with new and inventive specific features compared to the prior art products.

It is noted that amended claim meets requirements of patentability and it is believed that all formal requirements are now fulfilled by the present amendment so the application should be in order to proceed to acceptance.

No additional claim fee is required by this Amendment.

Respectfully submitted,

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